Novel Design and Analysis techniques for Image Inpainting

SYNOPSIS

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Abstract of proposed work plan problem

Over the decade's researchers have studied the inpainting problem intensively due to its high significance and effectiveness in various image processing applications such as people and object security, object removal, face editing applications. Image inpainting refers to restoration methods used to take away injure or unnecessary matter from an image, in a normal method, such that a disinterested viewer would not become aware of any changes and think the result as being the unique image. It is measured one of the most demanding topics in the image processing ground, although, it requires a deep thoughtful of the image information in terms of texture and structure. In this research paper we will presents a comprehensive survey of various image inpainting techniques with their advantages and disadvantages, study some problems associated with such techniques and try to find the possible solution.

1. Introduction

In actual world, many people require a method to improve the injured photographs, artwork, designs, drawings etc. injure may be due to a variety of reasons like scratches, overlaid text or graphics, scaled image etc. Traditionally, inpainting has been done by professional artists. On the other hand, we could not imagine the precision and value if it was done by human and time-consuming procedure. Image inpainting is a significant part in image renovation learning. Digital repair technology as introduced earliest by Bertalmio [Bertalmio et al. (2000)] [1]. After that it is extensively used in image processing, visual analysis and film industry.

Image inpainting refers to the method of filling/completing absent regions across images with an approximate calculation according to the nearby pixel information; it is a branch of image processing [2]. Image inpainting can be categorized into two main categories: Traditional techniques and deep learning techniques [2,3]. Conventional methods engaged either

dispersal based approaches that generated limited structures into the lost parts, or exemplar based approaches that fill the missing part's one pixel/patch at a time while preserving the consistency with the surrounding pixels. These conventional methods were appropriate for carrying out small absent regions such as a break in an image. Unluckily, image inpainting usual methods could not grip filling big difficult regions. Deep learning used for solving the complex task of image inpainting because these methods have shown excellent results for image inpainting over the past years.

2. Review of Literature and development in the subject (previous work done in the relevant area)

Various implementations have been introduced in the literature using various techniques.

In [2] Nermin M. Salem [2021] et al; presented a survey of most image inpainting techniques and summarized with comparisons. Different categories of approaches presented including traditional and deep learning approaches. They concluded that no method can inpaint all the types of distortion in images but using deep learning produce very promising results for each category of the analyzed cases. However, the problem of deep learning is the high computational complexity and high memory usage.

In [4] Zhen Qin [2021] et al; covered the inpainting methods of different types of neural network structure based on deep learning, then analyze and study import technical improvement mechanisms. In calculation, a variety of algorithms are methodically reviewed from the aspects of model network organization and renovation methods.

In [5] Rohit T. Pushpalwar [2016] et al; presented two major types of inpainting approaches that is 2D image inpainting and depth map inpainting. Current structure based inpainting methods are complex but give accurate results by preserving structure of missing regions after inpainting. Texture

based inpainting approaches mainly use patch based technique to fill the missing texture in image, but fail to preserve the structure. To defeat this control mutual structure and texture inpainting techniques can be used with the price of difficulty.

In [6] BianRu Li [2005] et al; proposed an image inpainting method based on the existing exemplar based image inpainting idea. Their method improves the robustness and effectiveness by rational confidence computing method, matching strategy and filling scheme. Therefore, their method effectively prevents growing garbage which is a common problem in other methods.

In [7] Mr. Mahesh Mahajan [2014] et al; proposed various types of image inpainting techniques which consist of exemplar based inpainting, multiresolution image inpainting, PDE based inpainting, fragment based image completion, completion of image with natural scenes, some fast inpainting techniques, some slow but better quality image producing techniques etc. From this detail survey they discussed the strengths and weaknesses of all image inpainting techniques.

In [8] Minquin Wang a [2011] et al; presented a novel method which decomposes the texture image into cartoon image and texture image, then inpaints structure based on boundary restoration and use texture synthesis to inpaint texture image. Their experimental results showed that it is effective to inpaint texture image with complex structure.

In [9] David Josue Barrientos Rojas [2020] et al; presented different image inpainting techniques included in traditional and deep learning techniques. None of the traditional are able to generate novel objects not found in the source image, they are unable to produce semantically consistent results. DL techniques fulfil this purpose a model to recognize the mapping between images and their labels.

In [10] Irina Maria Artinescu [2018] et al; proposed a new method of image reconstruction by inpainting small pattern over a damaged scratch, using a variant of the parallel projection method (PPM) for solving the convex feasibility problem. The method is based on a fragmentation of the damaged region in small quadrilaterals and reconstructs the image by filling the scratch with PPM generated pattern. The algorithm is fast and directly parallelizable.

In [11] H. Chinmayee Rao [2018] et al; urges on upgrading the image inpainting technique mainly for images involving edges and corner information. They built their algorithm on the exemplar based method of image inpainting. Their algorithm uses fractional derivative and additional curvature finding methods for finding data term in patch priority. Patch matching is performed using the traditional methods.

In [12] Raluca Vreja [2014] et al; presented comparative study in order to evaluate different types of image restoration methods and to emphasize the advantages and disadvantages for each of the approached algorithms based on the experiments, they proposed an adaptation of Oliveira's and Hadhoud's algorithms, which are performing well on images with natural defects.

In [13] Pranjali Joshi [2018] et al; give a survey of various systems utilized for picture inpainting. They talked about various inpainting systems like wavelet transform inpainting, exemplar based picture inpainting, PDE based picture inpainting, surface combination based picture inpainting.

In [14] Setika Mehra [2020] et al; presented review on various image inpainting techniques with an extensive survey on accentuating advantages and disadvantages for each of the technique presented. For applicability of image inpainting imparting optimum results in the field of loss concealment, object removal, image restoration or disocclusion, the information from nearby regions is seeked to acquire an image with restored absent

information. The result can be evaluated using subjective and objective analysis.

In [15] Li Zhao [2020] et al; presented inpainting model built on the basis of generating adversarial network, and residual network is used to effectively alleviate the problem of gradient disappearance and gradient explosion.

In [16] Minh-Trieu Tran [2021] et al; proposed an efficient multi-task learning network for medical image inpainting based on organ boundary awareness. They utilized the auxiliary tasks of edge and organ boundary prediction to make the model generate the sharp and clear images for inpainting by learning the detailed structure of organs.

In [17] S. Shivaranjani [2016] et al; studied various image inpainting techniques such as diffusion based inpainting, exemplar based inpainting, hierarchical super resolution based inpainting for improving the resolution and spatial patch blending algorithm for artefact reductions. A detailed explanation is given for each technique for filling he missing region and how to reduce the artefact that occurred after inpainting in order to improve the resolution is also discussed.

In [18] Kunti Patel [2015] et al; presented different methods for inpainting such as PDE based inpainting, texture synthesis based inpainting and exemplar based inpainting. According to analysis exemplar based inpainting is better as compare to others because that is efficient approach for reconstructing large target regions and also for texture and structural pattern.

3. Objectives of Research

The main objectives of this research are the improving or enhancing the damaged and the missing parts of the images.

1. To collect essential information and data sets of image inpainting techniques.
2. To do comparative study of applied techniques of image inpainting.

3. To produce complete recovered images in an unnoticeable manner to the human visual system.

4. Methodology to be adopted:

Different data sources to be used for this research work.

Many different type of data sources exist that includes Places2, CelebA, CelebA HQ, DTD, ImageNet, Depth image, Foreground-aware, SceneNet, Paris Street View etc. [3,4,9] Different types of techniques can be applied to these different kinds of database.

Different types of techniques include traditional methods and deep learning based methods. Further traditional methods includes Diffusion based, Patch based, Convolution filter based, Texture synthesis, Exemplar based, Hierarchical super resolution based, Spatial patch blending etc methods applied to different kinds of database. Deep learning image inpainting includes Non GAN (Generative Adversarial Network) based system, GAN based system, Convolutional Neural Network etc.

The proposed research work will be carried out through following steps for image inpainting.

a. Collection of Raw Data,
b. Data Fusion by using image processing techniques,
c. Development of Database,
d. Training and testing using applied methods,
e. Evaluation of Performance, and

The efforts will be made to increase the performance of proposed method. The above deep learning process may need to use more terminology for getting accurate results.

5. Importance of the study

i. International status /National status:

Inpainting is a preservation procedure where injured, declining, or missing parts of an artwork are filled in to there a whole image. The process can be applied to both physical and digital art mediums such as oil (Mona Lisa was created by Leonardo da Vinci using oil paints during the Renaissance art period in the 15th century) or acrylic paintings, chemical photographic prints, sculptures (Used in 3rd century Capitoline Museums, Rome), or digital images and video (Sony camera used for recording content).

The modern use of inpainting can be traced back to Pietro Edwards (1744-1821), Director of the Restoration of the Public Pictures in Venic, Italy. This is a superior tool for medical applications such as vascular restitution, elimination of specular reflections for endoscopic images, deletion of MRI artifacts, etc. (Chonnam National University, Yongbong and Don State Technical University, Russia and Coventry University, UK etc).

Deep learning methods are being used more frequently as time progresses in that they provide more successful results in complex problem compared to traditional methods. The main reason for this is the creation of large scale datasets that will enable the training of deep methods and the computational power that allow the training of these deep methods.

ii. Significance of the study:

The method of section filling subsequent the defeat of in sequence in digital images represents a significant feature in image processing. Image inpainting refers to reinstatement methods second-hand to take away injure or useless substance from an image, in a ordinary manner, such that a impartial witness would not become aware of any changes and think the result as being the unique image.

Traditional methods and Deep Learning based methods can be applied in variety of domains, which produce huge amount data which is required to be processed quickly.

Considering the above view, it is required to develop efficient algorithms using one of the above techniques for image inpainting. Proposed technique will help to provide second opinion to other researchers. Proposed algorithm may restore damaged images.

6. Proposed work plan

Plan of work and targets to be achieved in first year:

During the first year; an effort will be made to collect DataSet, information related to the present work using different books, research papers and journals. Also, efforts will be made to implement the existing algorithms relevant to our data. Two progress reports will be submitted at the end of this year.

Plan of work and targets to be achieved in second year:

During second year, some of the existing algorithms will be implemented on the database and data will be analysed. Improved algorithms will be applied on the database and results obtained will be compared. The research findings will be submitted in the form of two or more research papers to the internal research journals. Two progress reports will be submitted at the end of this year.

Plan of work and targets to be achieved in third year:

During this year, thesis writing will be started and publication of two research papers in reputed journals will be undertaken. Also, the research work will be presented in National/International seminars and conferences.

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